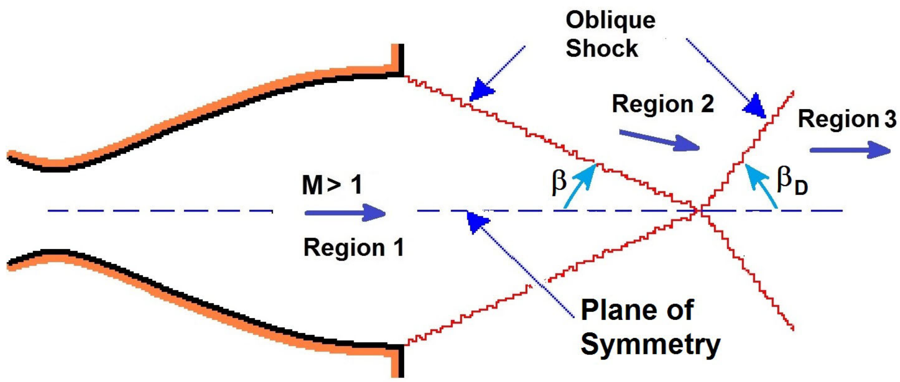
Solution to Problem 354A:



The flow exits the diffuser at a Mach number of 3.5. Because the surrounding atmospheric pressure is higher than the pressure of the exit jet, the engine is operating in an overexpanded mode and, hence, oblique shock waves occur emanating from the edges of the exit. These weak oblique shock waves are inclined at $\beta = 25°$ to the exhaust jet.

(1) The oblique shock graph for $M_1 = 3.5$ and a shock angle of $\beta = 25°$ shows that the flow deflection angle is $\theta = 10.3°$ relative to the axis. Therefore $M_1 \sin\beta = 1.48$. The shock wave table then tells us that $M_2 \sin(\beta - \theta) = 0.71$ and since $\beta - \theta = 14.7$ this leads to $M_2 = 2.8$.

(2) When the original oblique shocks meet two other weak oblique shocks are formed. We seek the angle of inclination, β_D, of these shocks. First note that the flow downstream of this second set of shocks must be parallel with the axis and so the angle of flow deflection from region 2 to the flow downstream of this second set must be 10.3°. Therefore from the oblique shock table or graph for a Mach number of 2.8 and a flow deflection of 10.3°, the inclination of this second shock relative to the M_2 flow direction must be 29°. Consequently the inclination of the second shock to the axis must be $\beta_D = 29° - 10.3° = 18.7°$.